

## Algorithms Inspired from Human Behavior Applied to Optimization of a Complex Process

**Authors :** S. Curteanu, F. Leon, M. Gavrilescu, S. A. Floria

**Abstract :** Optimization algorithms inspired from human behavior were applied in this approach, associated with neural networks models. The algorithms belong to human behaviors of learning and cooperation and human competitive behavior classes. For the first class, the main strategies include: random learning, individual learning, and social learning, and the selected algorithms are: simplified human learning optimization (SHLO), social learning optimization (SLO), and teaching-learning based optimization (TLBO). For the second class, the concept of learning is associated with competitiveness, and the selected algorithms are sports-inspired algorithms (with Football Game Algorithm, FGA and Volleyball Premier League, VPL) and Imperialist Competitive Algorithm (ICA). A real process, the synthesis of polyacrylamide-based multicomponent hydrogels, where some parameters are difficult to obtain experimentally, is considered as a case study. Reaction yield and swelling degree are predicted as a function of reaction conditions (acrylamide concentration, initiator concentration, crosslinking agent concentration, temperature, reaction time, and amount of inclusion polymer, which could be starch, poly(vinyl alcohol) or gelatin). The experimental results contain 175 data. Artificial neural networks are obtained in optimal form with biologically inspired algorithm; the optimization being performed at two levels: structural and parametric. Feedforward neural networks with one or two hidden layers and no more than 25 neurons in intermediate layers were obtained with values of correlation coefficient in the validation phase over 0.90. The best results were obtained with TLBO algorithm, correlation coefficient being 0.94 for an MLP(6:9:20:2) – a feedforward neural network with two hidden layers and 9 and 20, respectively, intermediate neurons. Good results obtained prove the efficiency of the optimization algorithms. More than the good results, what is important in this approach is the simulation methodology, including neural networks and optimization biologically inspired algorithms, which provide satisfactory results. In addition, the methodology developed in this approach is general and has flexibility so that it can be easily adapted to other processes in association with different types of models.

**Keywords :** artificial neural networks, human behaviors of learning and cooperation, human competitive behavior, optimization algorithms

**Conference Title :** ICAAIIPC 2022 : International Conference on Applications of Artificial Intelligence in Process Control

**Conference Location :** Istanbul, Türkiye

**Conference Dates :** June 27-28, 2022